

※ 注意：請於答案卷內之「選擇題作答區」依序作答。

選擇題每題 4 分，請依答案卷首頁所印題號序作答。計算過程可利用答案卷空白處書寫，但不計分。一些常數值： $c=3 \times 10^8$ m/s, $k=9 \times 10^9$ Nm²/C², $e=1.6 \times 10^{-19}$ C

1. What's the uncertainty of measured area for a rectangle with width 15.0 ± 0.3 cm and length 20.0 ± 0.2 cm, assuming the width and length measurements are uncorrelated? (A) 0.06 (B) 6.71 (C) 8.50 (D) 9.00 [cm²]
2. If one knows that the free-fall acceleration on the moon surface is about 1/6 of that on earth and the density of the moon is about 0.6 of the earth density, what is the closest estimate of the moon radius? You can use 6400 km as the average earth radius. (A) 1067 (B) 1778 (C) 2304 (D) 3840 [km]
3. If a neutron is scattered through 90° in an elastic collision with an initially stationary deuteron in the Lab. frame, what is the fractional loss of its kinetic energy assuming that the situation is non-relativistic and $m_{\text{deuteron}} = 2 m_{\text{neutron}}$? (A) 1/3 (B) 1/2 (C) 2/3 (D) 3/4
4. A point-like bug of mass m lies on the rim of a uniform disk of mass M that can rotate freely about its center. Initially the bug and disk rotate together with an angular velocity ω_0 . Then the bug walks half way to the center of the disk. What is ratio of the new kinetic energy of the system to its initial kinetic energy? (A) $(4m+2M)/(m+2M)$ (B) $(m+2M)/(4m+2M)$ (C) $(2m+4M)/(2m+M)$ (D) $(2m+M)/(2m+4M)$
5. The following functional form, $A \sin(kx + \omega t)$, represents a wave traveling along a string on the x axis with a linear density, μ . What is the wave velocity? (A) $-\omega/k$ (B) k/ω (C) A/μ (D) $(A/\mu)^{1/2}$
6. Assuming the sound emission frequency of a bat is 39 kHz. During one fast swoop directly toward a flat wall surface, the bat is moving at 0.025 times the speed of sound in air. What frequency does the bat hear reflected off the wall? (A) 38 (B) 39 (C) 40 (D) 41 [kHz]
7. What is roughly the mean free path for oxygen molecules at temperature of 300 K and pressure of 1.0 atm? Assume that molecular diameter is 0.3 nm and the gas is ideal. (A) 100 (B) 200 (C) 300 (D) 400 [nm]
8. What is the entropy change of a one-mole ideal gas system under free expansion to four times of its original volume? (A) 0 (B) $R \ln 2$ (C) $R \ln 3$ (D) $2R \ln 2$
9. With a 50Ω input impedance oscilloscope, one observes a 1 GHz noise with 20 mV amplitude through a coaxial cable. Approximately how many electrons are running back-and-forth at the input end due to this noise signal? (A) 10^3 (B) 10^6 (C) 10^9 (D) 10^{12}

10. Surge current is the instantaneous input current drawn by an electrical device when first turned on. It is larger than the current during normal operation. The cause of a larger current is mostly due what property of the electrical circuit of the device? (A) conductance (B) inductance (C) capacitance (D) resistance
11. There is a one-to-one analogy between the damped simple harmonic oscillator and the $R-L-C$ circuit. What property of an $R-L-C$ circuit matches the mass of the damped simple harmonic oscillator? (A) L (B) $1/L$ (C) C (D) $1/C$
12. A toroid has a donut shape. It is circular in cross section, with an inner radius of 4.0 cm and an outer radius of 6.0 cm (i.e. the diameter of the circular cross section is 2.0 cm), and is wound with 400 turns of wire. What current must be set up in the windings to attain an average magnetic around 4.0 mT in the toroid? (A) 1.5 (B) 2.0 (C) 2.5 (D) 3.0 [A]
13. Optic fibers are now important for telecommunication. What is the most important physical reason for the light to be capable to travel in optic fibers? (A) Huygens's principle. (B) Total internal reflection. (C) Dispersion. (D) Brewster's law.
14. Which of the following statements is true? (A) The Sun reflection light from your surroundings is partially polarized. (B) A simple magnifying lens is a diverging lens. (C) The index of reflection of a glass is smaller than that of the air. (D) The depth of a clean pond always looks deeper than it is.
15. Which is the basic physics of the anti-reflection coating technology? (A) Double-slit interference. (B) Total internal reflection. (C) The Michelson interference. (D) The thin-film interference.
16. A Compact Disc (CD) looks colorful at its surface is because it is a (A) diffraction grating. (B) thin-film interferometer. (C) Michelson interferometer. (D) thin lens.
17. Which of the following statements is true in the special relativity? (A) A moving clock ticks faster. (B) The length of an object along the moving direction is longer than it is at rest. (C) A massless particle must travel in the speed of light. (D) A neutrino can move faster than the speed of light.
18. Which of the following statements is true in the special relativity? (A) Kinetic energy is $p^2/(2m)$, where p is momentum and m is rest mass. (B) A person can still see his/her image reflecting from a mirror, as he/she is moving close to the speed of light. (C) Since $E=mc^2$ and the rest mass of a photon is zero, the energy of a photon is zero. (D) The momentum p is equal to the rest mass times the velocity.
19. Which of the following statements is false for a black-body radiation? (A) Sun is a black body. (B) Cavity radiation is a black-body radiation. (C) In order to explain the black-body radiation, M. Planck introduced the energy quantum of

radiation. (D) The spectrum of the black-body radiation does not depend on temperature.

20. What is the photon energy emitted from the transition from $n=2$ to $n=1$ in the hydrogen atom? (A) 10.2 meV. (B) 10.2 eV. (C) 10.2 keV. (D) 10.2 MeV.

21. Which of the following experiments shows no implication for quantum physics? (A) Temperature dependence of the specific heat of a diatomic gas. (B) Electron diffraction experiment. (C) Heinrich Hertz's experiment. (D) Photoemission experiment.

22. Which of the following experiments demonstrates that electrons have spin degree of freedom? (A) Stern-Gerlach experiment. (B) Frank-Hertz experiment. (C) Rutherford's experiment. (D) Compton scattering experiment.

23. Which of the followings is the energy level of the quantum simple harmonic oscillator? (h is the Planck constant, and ω is the angular frequency.) (A) $nh\omega/(2\pi)$. (B) $(n+1/2)h\omega/(2\pi)$. (C) $(n+1)h\omega/(2\pi)$. (D) $(n^2+1/2)h\omega/(2\pi)$.

24. How many quantum states are there in the n^{th} principal quantum level of the hydrogen atom? (A) $n-1$. (B) n^2 . (C) $2n^2$. (D) n^2-1 .

25. Which of the following properties is wrong for a semiconductor? (A) Obeying Ohm's law. (B) Can be doped to increase conductivity. (C) Can make light-emitting diodes. (D) Can make transistors.